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ABSTRACT

A computer-based educational game is used to introduce students to strategy formation and decision-making about portfolio management. Bookkeeping programs assign sums of money to students and allow them to conduct transactions on 5000 listed stocks. Weekly printouts give financial statements and student performances are compared to that of a randomly generated portfolio. Competition among student groups and between students and other players from the business world is used to motivate students to learn investment concepts and to develop analytical skills. Feedback from the players indicates that two-thirds of them strongly approve of the game. Since the operating cost to the department is only $20 per week for 50 to 60 students, the game is an efficient way of introducing students to the complexities of managing investments. (LB)

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'THE MONEY GAME' AS A CLASSROOM EXERCISE

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In the past, the principal focus of investments courses has been to describe the various forms of financial securities available in the market, the sources of information available for use in evaluating these securities and analytic techniques which might be used to perform the evaluation. Much of the evaluative effort represented meager attempts to forecast future events by drawing on the concepts and concerns of other areas such as accounting, economics and statistics.

Over the last several years less attention has been paid to the arduous process of forming expectations; which requires not only familiarity with many academic fields, but the very vague attributes of maturity and intuition as well. To fill the void, more concern has been given to the strategies which should be employed, given that the expectations have been formulated somehow.

Recognizing that investment decisions have a future orientation and that predictive errors are bound to occur; some of the main preoccupations of today's investments courses deal with suitable methods of quantifying this error, discussing how investors might react to varying magnitudes of error, and developing strategies to meet the uncertainty of the future in an optimal way. The more popular strategies tend to suggest that investment performance can be improved by allocating one's funds across groups of securities; that is, by investing in portfolios rather than in an individual security.

This, of course, leads to the more operational questions of how many securities should be considered and in what proportion they should be held.

The shift towards the broader, and usually more abstract, perspective of portfolio management presents a distinct challenge to the teacher of large numbers of students with learn-how-to-get-rich-quick expectations. How is it possible to provide these students with realistic problems, which can be monitored, in order to stimulate their interest and enhance their understanding? This paper will describe an attempt to meet this challenge.

An Overview

To construct a "real-world" setting, a series of elaborate bookkeeping programs was devised [1]. Each student is assigned a hypothetical sum of money at the beginning of the semester and may purchase, sell, sell-short [2] or terminate a short position, for any one of the approximately 5000 listed securities [3]. The programs furnish weekly financial statements for each student which reflect the results of their trading decisions after taking transactions costs into account. These statements include an inventory of their portfolios at current market prices and overall ranking of their performance.

Whenever efforts of this nature are undertaken, several objectives need to be considered. The novel feature of this set of programs lies in the particular blend of compromises which were made while trying to satisfy each objective as fully as possible.

It would, of course, be nice to construct a recording system identical in all respects to one found in a brokerage house. Unfortunately, academic institutions cannot afford personnel to write the trading orders, punch the data cards, and perform the myriad of other auxiliary chores required. Only three labor units are available; the computer, the participating students or players, and a nominal amount of funded assistance (equivalent to one student grader). Part of the detailed work of input preparation must, therefore, be performed by the players; and herein lies one of the major difficulties in the design of the programs.

The one talent which nearly all students possess in abundance is the facility to make careless errors. Thus, it becomes imperative that they receive a minimum number of very clear instructions [4]. In addition, precautions need to be taken to detect all errors which they will make.

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There is an additional reason to constrain student input. A player's success is measured by the amount of money he makes over the course of the semester. His gains are a function of the movement of the prices of the securities he selects. To prevent chaos and maintain control, either prices provided by the students must be carefully monitored or they should be provided by an independent party. We chose to take the latter course.

Constraining the player input naturally shifts the burden to either the computer or the funded student assistant. Neither of these resources are available in unlimited quantities so additional allocative judgements had to be made, including a retreat from perfect realism [5].

The foregoing was simply intended to convey to the reader the essence of the trade-offs which had to be considered while designing the programs. The details of the inputs and outputs will now be presented.

Required Player Input

A listing of the securities which can be traded is made available to all players. This listing assigns numerical identification to the stocks listed in the Wall Street Journal. Once this list is established it remains constant over the duration of the game. That is, no additions or other modifications are possible.

Also, each group of players is assigned a group identification number. (The players are encouraged to form groups of two or three in order to benefit from the dialogue which will result during the decision-making process.)

To initiate a transaction the player has to punch one data card which contains only four pieces of information. First, however, asterisks must be punched in columns 1, 11, 21 and 31 to define three fields of nine columns into which the first three items must be entered. If these asterisks are mispunched the card is automatically rejected and the transaction is voided.

The group number is punched anywhere between columns 1 and 11, the stock identification number anywhere between columns 11 and 21, and the number of shares to be traded anywhere between columns 21 and 31. All of these are punched with decimals. Since the asterisks have been included, it is a simple matter for the student assistant to list all the transaction cards, to scan the listing for mispunches, and to make any corrections for such obvious errors as omitted decimals.

The fourth piece of required data is a transaction code punched in column 80. A "B" initiates a buy order. An "S" initiates a sale, or terminates a short position. Since the players are not allowed to hold simultaneously both a long and a short position in any given stock, an S wipes out all, or part of, an existing long or short position as the case may be. To initiate a short sale an S is used again, only with the additional requirement that the number of shares be preceeded by a minus to indicate he is selling shares he does not own. Any other punches in column 80 are considered errors and the transaction card is ignored. To recapitulate:

To Initiate	Punch in Column 80	Other Special Requirements
A buy order	B	Must have sufficient cash to cover purchase
A sell order	S	Must own at least the number of shares sold
A short sale	S	Punch a minus before the number of shares traded
The termination of a short position	S	Have a short position of at least the number of shares terminated

It is also possible for the student to claim any dividends he is entitled to receive and to make corrections to his cash balance. Due to the space provided the required instructions will not be detailed here. They are simple, however. If a cash correction is made, five rows of asterisks are printed across the bottom of the financial statement. This makes any abuse easy to detect by scanning the duplicate copy of the output.

Processing the Player Input

Since inventories are maintained (on disk) for each group throughout the semester it is important that the data used to update these inventories be error free. Therefore, two programs are used to process the student generated data whenever the transactions are run [6].

The first program, called PREPORT, reads in the student prepared data and cards for all stocks previously traded [7] and generates three distinct outputs. First, new students' transaction cards are machine punched with the group number properly alligned for subsequent sorting purposes [8]. Second, a listing is prepared in numerical order, of all the stocks traded through the current week together with a corresponding set of punched cards.

The student assistant spends the bulk of his time punching current prices into these cards. They are in the same order as they appear in the Wall Street Journal so the task takes, at the outside, about an hour each time transactions are permitted. Rarely has the list of traded stocks exceeded 250 items even with as many as 60 groups playing the game.

After completing the pricing, the assistant merely sorts the machine punched transaction cards by transaction type and then by group number. Following this, he feeds the transaction cards and price data into a second program called REPORT. This program produces financial statements for the players.

Description of the Financial Statements

The central statement is a balance sheet which details the composition of the student's wealth. At the end of three weeks of play one group showed the following:

Composition of Wealth, Group 207

Week Ending 10/4/72

Ending Cash Balance	$ 24,247.93
Current Market Value of Ending Inventory	76,265.99
Total Ending Wealth	$100,513.92

Each of the component balances is then broken down in detail. The following is a partial listing of the ending inventory.

Ending Inventory, Group 207

10/4/72

Position	Stock I.D. No.	Stock Name	Number of Shares	Price Per Share	Current Market Value
Long	944	Magnox	100	$28.63	$ 2,863.00
.	.	.	.	.	.
.	.	.	.	.	.
.	.	.	.	.	.
Long	912	Litton Ind.	100	12.63	1,263.00
Short	1431	Sterl Drug	100	34.50	-3,450.00
				Total	$76,265.99

The validity of the ending cash balance is established by reconciling to the prior week's ending balance.

Reconciliaton of Cash Balance

		Total	Free	Constrained
Beginning balance		12,114.23	9039.23	3075.00
Add: Dividends	-0-			
Sales	21,131.14			
Short Sales	-0-			
Deduct: Purchases	-8,997.44			
Termination of short positions	-0-			
Net effect of transactions		12,133.70		
Ending balance		24,247.93	20,797.93	3450.00

The total cash balance is broken down into a free and a constrained component. The constrained cash represents the amount which must be maintained in order to liquidate all the short positions in the inventory. Purchases cannot be made with these funds.

During the week reported above, the value of the stock held short increased from $3075.00 to $3450.00 Accordingly $375 was automatically transferred from the free cash to the constrained cash balance. The increase of $11,758.70 in the free cash balance is explained by the net effect of the transactions, $12,133.70, less the amount transferred from free to constrained cash to cover the short position.

The final set of statements simply presents the details of the aggregates shown in the cash reconciliation. For example:

Purchases

Stock ID. No.	Stock Name	Number of Shares	Price Per Share	Tot. before Trans. Costs	Trans Costs	Total After Trans. Costs
944	Magnvox	100	$28.63	$2863.00	33.31	2896.31
1157	Owen Cvg	100	46.50	4650.00	42.25	4692.25
204	Branif Airw	100	13.88	1388.00	20.88	1408.88
				$8901.00	96.44	8997.44

While not shown in the illustration, odd-lots may be purchased and are charged the appropriate premium transaction costs.

Special Features

An important feature of the game is the random portfolio. At the beginning of each semester the student assistant selects fifteen stocks by use of a table of random numbers, and purchases approximately $666.66 of each (after adjusting to provide for round-lot purchases). This acts as a target for the players. Each week the player's ending wealth is divided by the ending wealth in the random portfolio to provide a simple index of relative performance. This stimulates the students since it is somewhat humiliating to be outperformed by chance.

Also, a measure of the rate of return earned is calculated by dividing the gain or loss by the initial wealth [9]. This rate and the index described above are used to rank the players each week (or each time new tranactions are recorded). The ranking, provided automatically by the REPORT program, is posted weekly to keep the players informed of their standings.

Motivational Aspects

Some competitive spirit is stimulated by the game, but the interest can be accentuated by a variety of means. We have based a proportion of the course grade on the player's final standing in the game. After polling the students, a figure of 25% was agreed upon. The poll was taken early in the semester, at which time several students were willing to let as much as 75% of their grade be determined in this fashion. (As the semester wore on they became more conservative).

Another motivational device is to invite local businessmen and brokers to participate. This is relatively easy to do since many people have pet theories or strategies which they think will work. Often, they have begun to test their ideas hypothetically, only to get bogged down by the number of calculations required. If someone offers them a free bookkeeping service they are usually only too happy to try their hand.

When the number of businessmen in the game is kept to ten or less the burden of punching their transaction cards is negligible. Thus, they simply have to phone in their orders.

The presence of the businessmen in the game lends an air of seriousness of purpose to the entire effort. Students tend to be impressed by the fact that practitioners think enough of the exercise to spend the time required. Futhermore, they are challenged by this outside source of competition.

Many shcools across the country have obtained funds from banks and other institutions which students may invest, subject to various constraints. The general rule seems to be that some proportion of the gains and dividend income is reverted to charitable uses and the remainder is reinvested. The objective in having students invest "real money" is to stimulate their interest in financial matters. No doubt this approach serves this purpose rather well, but it is subject to some rather serious disadvantages. First, only a limited number of advanced students are allowed to participate in the investment activity. Second, the students are allowed to participate in the investment activity. Second, the studerts usually do not receive any direct monetary award. Third, time-consuming faculty supervisory activity is usually required. Fourth, the granting institutions must be persuaded to donate (or risk the loss of) rather large sums of money in order to establish portfolios of manageable proportions.

The series of programs described here affords detailed reporting of the decisions of large numbers of students at avery low cost. Typically, 50 to 60 groups of 2 to 3 studerts have paricipated every semester [10].

The ability to reach this many students is very appealing to those granting institutions which are willing to donate funds for these types of activities. Even more appealing, however, is that the funds required can be substantially reduced. Perhaps more interest can be stimulated by granting monetary awards to the winning players. The institutions need to set aside less money to generate a stream of future awards than they would have to forego in order to set-up a large portfolio; and there is no risk of losing the principle amount donated. In addition, the students are more likely to respond to the chance of a $300 prize than to the chance of a pat on the back for a job well done.

Some critics of these types of attempts to motivate point out that the period of time over which the students are involved is so short that they will view investment in the market as a purely speculative activity. There is validity to this argument.

Nevertheless, there are benefits beyond the development of a core of Wall Street Journal readers. Most students, graduate and undergraduate alike, have had precious little exposure to decision making in the face of true uncertainty. Predictable, after their first brush with the game, they begin to feel ill at ease and to complain that they really don't have sufficient information upon which to base their decisions. How refreshing! Their frustration gets progressively worse as they search for substantive comments in the professional analysts' research reports, as they read contradictory opinions about the future, as they become exposed to concepts of growth, risk, risk-adjusted discount rates, the effects of financial leverage, various portfolio management strategies, and so on. If skillfully handled, many students make heroic attempts to reconcile the reasonable sounding classroom concepts with the reality in which they are involved in order to dissipate their frustration. In short, they think.

As they begin to acquire a feeling for the extreme complexity of investment decisions they accept the classroom concepts more readily, as long as these concepts are presented as structures which can be used to improve their analytical prowess, as opposed to absolute answers. Further, they begin to develop an intuitive feel for the entrepreneural life. They begin to understand what it is like to make decisions rather than to follow rules. Far too much of the education business students receive is too comfortable for them. This game is not [11].

Summary

This computer "game" is an example of the use of computing facilities for primarily "bookkeeping" operations. However, without the use of the computer the game would not exist due to the large number of man-hours required to perform the necessary activities. As noted

previously, the total CPU time involved for 50 to 60 groups of students on our 360/65 system is approximately .021 hours per "trading day." All computer charges included, the cost to the department is less than $20 per week to run the game as charged by this university. Student assistant time is approximately 2 hours per week.

The game is reasonable realistic in that it allows students to perform the usual transactions on securities listed in the Wall Street Journal with the exception of margin purchases, stop orders, puts, and calls. These options were omitted in order to conserve student, computer, and grader time. Additionally, a portion of the burden of running the game was passed on to the players in that they are responsible for the accurate keypunching of their transaction cards (any errors detected by the program result in an ignored transaction), thus minimizing grader time and unnecessary reruns of the program. The ranking procedure has been beneficial in increasing competition among the groups. Extra impetus was provided by comparing each group's performance to that of a randomly chosen portfolio, as most groups are reluctant to allow a randomly chosen portfolio to outperform their best efforts.

Feedback from the players indicate that the vast majority (67%) were in favor of having the game become an integral part of the course. The remainder were mostly indifferent. Only 6% expressed opposition. As further evidence of student interest, we have received many requests each semester from students who have completed the course to continue playing the game. Thus, the costs of operating the game are indeed miniscule when compared with the benefits.

NOTES

1. In all, four separate programs are used. Two of these programs are used only once at the beginning of the semester to set up the groups and the list of securitites and will not be described here.

2. A short sale is a transaction which permits an investor to sell securities he does not currently own (but borrows) in the hopes of buying them back at some future date at a lower price.

3. Stanford University uses a game similar to the one described here. There are significant differences between the games, however. First, in the Stanford game students are constrained to a selection of only 60 securities. Furthermore, their game is designed for use by a limited number of groups comprised of graduate students, whereas the game described here can be used conveniently with large numbers of undergraduate students, due to the simplicity of the inputs required from them. This design makes it easy to accommodate the inclusion of businessmen and other professionals as participants. Also, this game provides an automatic monitoring system which makes it unnecessary for the instructor to be familiar with the details of the activities in the players' portfolios, while insuring that they comply with the rules.

4. The current set of instructions has been used for five semesters. The students have experienced no difficulty in understanding the instructions.

5. More specifically, no provision was made for buying on margin or for special types of transactions such as stop orders.

6. These transactions could be run as often as once each day. We are currently allowing trading only one day in each week.

7. This data was provided by running PREPORT during the previous week.

8. The data could be saved on tape. However, for the relatively small number of cards involved, punched output was convenient.

9. It is convenient, but not necessary, to give all the players the same amount of funds at the beginning of the game. If this practice is not followed, rates of return must be used for ranking purposes.

10. For this volume of students PREPORT requires approximately .001 hours of CPU time and REPORT .012 hours of CPU time each time they are run on an IBM 360/65 computer.

11. Also, they have access to various other canned programs which they may use if they so desire. These include regression programs, exponential smoothing programs, a quadratic programming routine, and others.